

United States General Accounting Office

GAO

Report to the Secretary of Defense

AD-A260 208



January 1993

ELECTRONIC WARFARE

Laser Warning System Production Should Be Limited

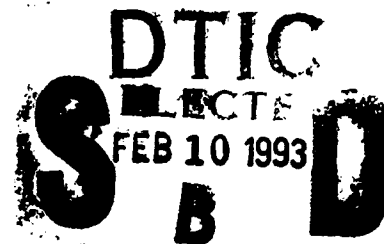


GAO/NSIAD-93-14

National Security and
International Affairs Division

B-250665

January 25, 1993

The Honorable Richard B. Cheney
The Secretary of Defense

Dear Mr. Secretary:

We have evaluated the Army's test program for the AVR-2 laser warning system and a newly modified version designated the AVR-2A. We focused specifically on whether the testing accomplished justifies the systems' full-rate production status.

Background

The AVR-2 and AVR-2A are intended for use on combat helicopters to protect against threat weapons that rely on lasers for their operation. (See fig. 1.) Some of these weapons are guided by lasers while others are aided by lasers in accomplishing such functions as determining the range to target aircraft. The AVR-2 and AVR-2A protect against such threats by detecting laser energy, providing an audio warning, and displaying the type and location of the threat on a screen in the helicopter cockpit. Based on the warning information, the pilot may launch an attack against the threat or attempt to evade it.

The Army started development of the AVR-2 in the 1970s. After the system completed initial operational tests in 1985, the Army modified its design to overcome performance problems and awarded the initial production contract in 1988. The AVR-2A subsequently evolved from additional design changes to the AVR-2. Full-rate production of the AVR-2 was approved in February 1992. The AVR-2A is expected to be phased into production in early 1993 and deliveries are scheduled to start in July 1993. So far, the Army has contracted for 940 systems, including 519 AVR-2s and 421 AVR-2As. Total program requirements are for 1,782 systems (1,472 for the Army, 254 for the Marine Corps, and 56 for the Navy) at an estimated program cost of \$261 million.

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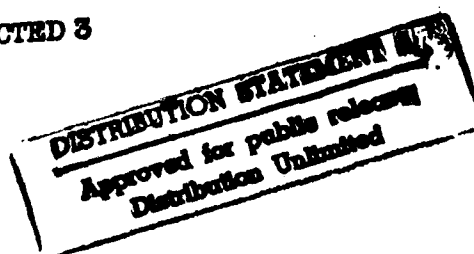
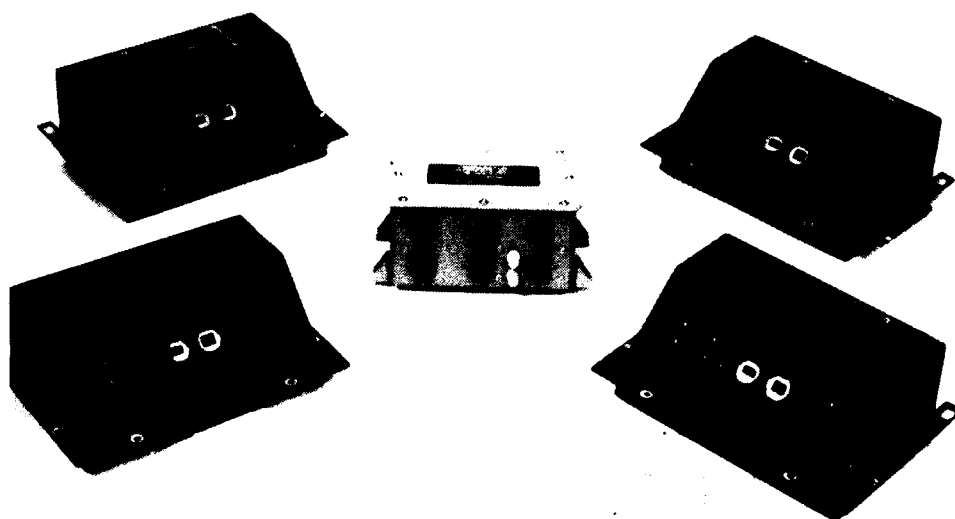


Figure 1: Cobra Attack Helicopter and
AVR-2 Laser Warning System



Results in Brief

Production of the AVR-2 and AVR-2A should be minimized until successful completion of operational tests. The AVR-2 failed to demonstrate acceptable performance in its operational tests and was redesigned. Even though half of the total quantity required has been procured, neither the redesigned AVR-2 nor the further redesigned AVR-2A has been subjected to operational tests to ensure satisfactory performance. This is contrary to Department of Defense (DOD) acquisition policy, and as a result, the Army risks procuring an inventory of systems that could prove defective.

AVR-2 and AVR-2A Have Not Demonstrated Acceptable Performance in Operational Tests

The performance capability of the redesigned AVR-2 and AVR-2A now being procured is unproven because neither system has been subjected to operational tests. At the time of our review, the Army did not plan to conduct any such operational tests, contrary to DOD policy.

Importance of Operational Testing

Operational testing is DOD's primary means of evaluating weapon system performance in a combat representative environment. It can help reduce risks in acquisition programs by identifying defective systems before they are produced and by verifying the correction of performance deficiencies. Operational testing is distinguished from developmental testing, which is done to verify that technical performance specifications are met and to determine whether a system is ready for operational testing.

DOD's acquisition policy provides that operational testing shall be structured to determine the operational effectiveness and suitability¹ of a system under realistic combat conditions and to determine if the minimum acceptable operational performance requirements have been satisfied. The policy further provides that a system may not enter full-rate production until test results provide reasonable assurance that the design is operationally acceptable. It also provides that one of the objectives of the production phase is to conduct follow-on operational testing to confirm system performance and verify the correction of deficiencies.

¹Operational effectiveness refers to the ability of a system to accomplish its mission in the planned operational environment. Operational suitability is the degree to which a system can be placed satisfactorily in field use considering such factors as reliability and maintainability.

No Operational Tests Planned

During operational tests in 1985, the original AVR-2 failed to demonstrate acceptable performance. Major shortcomings included an inability to detect multiple threats, an inability to operate properly with the helicopter's APR-39A radar warning receiver,² and a tendency to provide false warnings. The system also failed to demonstrate that it met reliability requirements. In addition, the system configuration tested weighed 22.2 pounds, or 2.2 pounds over the maximum allowable weight.

Following the 1985 operational tests of the AVR-2, the Army made design changes to improve the system's performance and reduce its weight. These changes included redesigning the system's receiver and electronic components at a cost of \$3.4 million, or 30 percent of the system's original development cost of \$11.4 million. The changes also increased unit production cost by \$3,890, to \$125,251 each.

In early 1991, the Army began a series of additional design changes to the AVR-2 to improve the system's sensitivity and thereby allow detection of certain threat systems at greater ranges. Modifications were also made to incorporate a device that will allow its use with a training system for Army pilots. The modifications cost about \$8 million, or 70 percent of the system's original development cost, and increased unit production cost by \$9,061, to \$134,312 each. The resulting system was designated the AVR-2A.

Despite the changes in system design and DOD's stated policy, the Army decided that follow-on operational testing was not necessary. Consistent with DOD policy, the Army did plan to conduct follow-on operational testing in 1991 using production models of the redesigned AVR-2. According to the test plan, several critical issues were to be evaluated, including the system's operational effectiveness and reliability. However, the follow-on test was canceled because of Operation Desert Storm.

Substitute Testing Is Inadequate

Rather than conduct follow-on operational testing, the Army planned to rely on technical tests to demonstrate system performance. However, these tests are not a valid substitute for operational tests.

Technical testing is essentially developmental testing and is not done in a realistic operational environment needed to evaluate a system's operational effectiveness and suitability. For example, tests to demonstrate the AVR-2's reliability were held in the contractor's plant and were not done under the cognizance of the Army's independent

²A radar warning receiver is an electronic warfare system to warn of radar controlled threat systems.

operational test organization. Moreover, DOD policy provides for demonstrating a system's operational effectiveness and suitability in operational tests, not technical tests.

Our work has shown that failure to conduct operational testing to verify the adequacy of redesigned systems can result in adverse consequences. On a recent review of another Army electronic warfare system,³ we found that design changes were made to correct a serious shortcoming discovered during operational testing. However, no additional operational testing was done to verify the adequacy of the changes. Subsequently, during Operation Desert Storm, the system proved so defective that Army pilots stopped using it.

In addition, at the time of our review, none of the substitute testing had been or was planned to be done on the Army's Apache helicopter, the main aircraft slated to use the AVR-2A. During a recent review of a Navy electronic warfare system, we found that the system had successfully passed operational testing on a certain helicopter. Based on those tests, the Navy procured several hundred systems and then operationally tested the system on another helicopter scheduled to use the system. Those tests showed that the system degraded rather than enhanced the other helicopter's survivability.

Another limitation of the Army's substitute testing is illustrated by the AVR-2's electromagnetic compatibility tests. These tests refer to the capability of systems to operate in their intended environments without causing or suffering from interference with other systems. The AVR-2 electromagnetic compatibility tests were conducted on a Scout helicopter that had much of its electronic equipment either missing or inoperative. In addition, the Scout does not have some equipment, such as the ALQ-136 radar jammer, that is used on the Apache and Cobra helicopters. Thus, the Army has little assurance of the AVR-2's electromagnetic compatibility.

Recommendation

We recommend that the Secretary of Defense require that production of the AVR-2 and AVR-2A be minimized until operational testing provides reasonable assurance that performance is satisfactory.

Agency Comments

DOD partially agreed with the findings in this report but disagreed with the recommendation. DOD stated that adequate operational testing had been

³This was reported in a 1992 classified GAO report.

conducted or was planned to reasonably ensure operationally suitable and effective system performance.

However, at the time of our review, operational testing of the AVR-2 had revealed performance deficiencies, and no additional operational testing had been planned. In responding to the draft of this report, DOD agreed that operational testing on the Apache helicopter was needed. DOD officials informed us that this testing was planned in response to the draft report and that it would take place in April to June 1993.

Even though DOD disagreed with our recommendation, we consider DOD's planned test to be partially responsive to our recommendation, assuming that this and other tests indicated in DOD's comments are accomplished as planned. We believe that the tests will reduce the Army's risk of procuring deficient systems. However, we also believe that the risk could be further reduced by minimizing production until the tests are successfully accomplished.

DOD's detailed comments on the draft of this report are reprinted in appendix I.

Scope and Methodology

We performed our work at the Army's AVR-2 System Program Office, St. Louis, Missouri; the Army Communications-Electronics Command, Fort Monmouth, New Jersey; the Army Operational Test and Evaluation Command, Alexandria, Virginia; and the Army Aviation Center and School, Fort Rucker, Alabama. We reviewed system test plans and reports, requirements documents, contractual records, system configuration control records, DOD acquisition policy directives, and other records bearing on the issue. We also discussed various aspects of our work with Army officials. We performed our work from February 1992 through September 1992 in accordance with generally accepted government auditing standards.

As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement on actions taken on our recommendation to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report. A written statement must also be submitted to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Chairmen of the above Committees and of the Senate and House Committees on Armed Services, the Secretary of the Army, the Director of the Office of Management and Budget, and other interested parties. Please contact me at (202) 275-4841 if you or your staff have any questions concerning this report. Other major contributors to this report were Jackie B. Guin, Assistant Director, and Donald F. Lopes, Evaluator-in-Charge.

Sincerely yours,

A handwritten signature in cursive script, reading "Louis J. Rodrigues". The signature is written in dark ink and is positioned above the printed name and title.

Louis J. Rodrigues
Director, Command, Control, Communications,
and Intelligence Issues

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



ACQUISITION

OFFICE OF THE UNDER SECRETARY OF DEFENSE

WASHINGTON, DC 20301-3000

16 DEC 1992

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report entitled, "ELECTRONIC WARFARE: Laser Warning System Production Should Be Limited" (GAO Code 395192/OSD Case 9260). The Department partially concurs with the report findings, and nonconcurs with the recommendation.

The GAO concluded that the redesigned AVR-2 and AVR-2A laser warning systems being procured by the Army are unproven because neither system has been subjected to operational testing in accordance with DoD policy. The GAO based its conclusion on the fact that operational deficiencies were noted during operational testing conducted in 1985 on the initial production AVR-2 system and that reliability had not been assessed during this testing. Additionally, the GAO concluded that the redesign of the AVR-2 and AVR-2A represented a material change to the performance of the system.

In reporting the 1985 test results, however, the independent operational test organization, U.S. Army Operational Test and Evaluation Command, concluded that the AVR-2 was "operationally suitable and increased the aircraft survivability." Further, the Navy operationally tested the system in 1987, and also concluded that the system was operationally suitable and effective. Additionally, the Army independent operational tester stated that there are no outstanding operational issues for the system, after concluding that developmental and first article test results had resolved outstanding operational deficiencies, to include reliability. Subsequently, the Army independent operational tester concluded that follow-on operational testing of the AVR-2 system was not warranted. That position was supported by both Army and Navy users, as well as the Navy independent operational tester. Regarding the "redesigned" AVR-2 and AVR-2A, the Army independent operational tester and the user concluded that neither of those system changes represented a material change, in hardware or software, to the performance of the systems that would warrant follow-on operational testing.

See comment 1.

See comment 2.

See comment 3.

See comment 4.

Appendix I
Comments From the Department of Defense

See comment 5.
See comment 4.

See comment 6.

The Department, therefore, disagrees that operational testing on the initial AVR-2 was noncompliant with DoD policy, or that the redesign of the AVR-2 and AVR-2A was materially significant so as to warrant follow-on operational testing. The Department does, however, agree that it is desirable to test the integration of the AVR-2A on the main aircraft of intended use, the AH-64 Apache helicopter. The Army plans to conduct that testing as part of a coordinated test and evaluation effort with the Army independent operational tester and user. The Apache testing is scheduled for later in FY 1993.

The Department also does not agree with the GAO recommendation to limit AVR-2 and AVR-2A production, based on the premise that inadequate operational testing has been conducted or is planned. Adequate operational testing by both the Army and Navy has been conducted or is planned to support full-rate production. The operational needs of both Services warrant scheduled introduction of the AVR-2 and AVR-2A on designated aircraft.

Sincerely,



Frank Kendall
Director
Tactical Systems

GAO DRAFT REPORT - DATED NOVEMBER 10, 1992
(GAO CODE 395192) OSD CASE 9260

**"ELECTRONIC WARFARE: LASER WARNING SYSTEM
PRODUCTION SHOULD BE LIMITED"**

DEPARTMENT OF DEFENSE COMMENTS

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FINDINGS

- **FINDING A: Importance of Operational Testing.** The GAO concluded that the performance capability of the redesigned AVR-2 and AVR-2A now being procured is unproven, because neither system has been subjected to operational tests. The GAO pointed out that, contrary to DoD policy, the Army does not plan to conduct any such operational tests. The GAO asserted that operational testing is the primary means the DoD has of evaluating weapon system performance in a combat representative environment--and that such testing can help reduce risks in acquisition programs by (1) identifying defective systems before they are produced, and (2) verifying the correction of performance deficiencies. The GAO explained that operational testing is distinguished from developmental testing, which is done to verify that technical performance specifications are met and to determine whether a system is ready for operational testing.

The GAO contended the DoD acquisition policy provides that operational testing shall be structured to determine the operational effectiveness and suitability of a system under realistic combat conditions and to determine if the minimum acceptable operational performance requirements have been satisfied. The GAO further contended the DoD policy provides that a system may not enter full-rate production until test results provide reasonable assurance that the design is operationally acceptable. In addition, the GAO asserted that DoD acquisition policy provides that one of the objectives of the production phase is to conduct follow-on operational testing to confirm system performance and verify the correction of deficiencies. (pp. 4-5/GAO Draft Report)

DOD RESPONSE: Partially concur. The Department disagrees that the performance capability of the "redesigned" AVR-2 and AVR-2A is unproven in operational testing. A production representative AVR-2 was operationally tested in 1985. The changes incorporated into the AVR-2 did not materially change system performance and, therefore, in accordance with Department of Defense Instruction 5000.2 do

Now on p. 3.

See comments 4 and 5.

See comment 2.

See comment 7.

See comment 3.

not require a separate operational test. Additionally, the Navy conducted an operational test of the AVR-2, in 1987, and found the system to be both operationally effective and suitable. The modifications which resulted in the new type classification AVR-2A improved upon the performance previously demonstrated. The addition of the multiple integrated laser engagement system compatibility is a training enhancement to the system and does not represent an operational performance capability. The user currently has no outstanding operational issues for the program.

- **FINDING B: No Operational Tests Planned.** The GAO reported that, during operational tests in 1985, the original AVR-2 failed to demonstrate acceptable performance. The GAO found that major shortcomings included (1) an inability to detect multiple threats, (2) an inability to operate properly with helicopter APR-39A radar warning receivers, and (3) a tendency to provide false warnings. In addition, the GAO observed that the system also failed to demonstrate that it met reliability requirements. Further, the GAO observed that the system configuration used in testing weighed 22.2 pounds, or 2.2 pounds over the maximum allowable weight.

The GAO found that, following the 1985 operational tests of the AVR-2, the Army made design changes to improve system performance and reduce weight. The GAO reported that the changes included redesigning the system receiver and electronic components at a cost of \$3.4 million, or 30 percent of the system original development cost of \$11.4 million. The GAO further reported that the changes also increased unit production cost by \$3,890. The GAO explained that, in 1991, the Army began a series of additional design changes to the AVR-2 to improve the system sensitivity, and thereby allow detection of certain threat systems at greater ranges. In addition, the GAO found modifications were also made to incorporate a device that will allow its use with a training system for Army pilots. The GAO estimated the modifications cost about \$8 million--or 70 percent of the original development cost of the system--and increased unit production cost by \$9,061, to \$134,312 each.

The GAO contended that, despite the changes in system design and DoD stated policy, the Army has decided that follow-on operational testing is not necessary. The GAO noted that, consistent with DoD policy, the Army did plan to conduct follow-on operational testing in 1991--using production models of the redesigned AVR-2. The GAO observed that, according to the test plan, several critical issues were to be evaluated, including the operational effectiveness and reliability of the system. The GAO noted, however, that the follow-on test was canceled

Now on p. 4.

See comments 3 and 4.

See comments 3 and 5.

because of OPERATION DESERT STORM. (pp. 5-6/GAO Draft Report)

DOD RESPONSE: Partially concur. The user has determined that there are no outstanding operational issues. The modifications have not changed the operational performance of the AVR-2/2A system so as to warrant additional operational testing. System weight reduction was demonstrated by physically weighing the system. The operational requirement for reliability is 200 hours, the contract requirement is 400 hours, and first article testing demonstrated over 600 hours reliability. Technical testing and first article testing results were accepted by the Army Operational Test and Evaluation Command in concluding that deficiencies, noted during 1985 operational testing, had been corrected. To that extent, the Army Operational Test and Evaluation Command concluded no operational issues remained for the AVR-2. Regarding the AVR-2A, the Army Operational Test and Evaluation Command recommended that a follow-on operational test be conducted, only if open issues remain that cannot be satisfactorily addressed in other testing. Platform specific, follow-on operational testing is ongoing by the Navy in the UH-1N helicopter to obtain additional data on the AVR-2/APR-39 compatibility and false alarm indications. The Army will validate the integration of the AVR-2A on the AH-64 in testing to be conducted during the second half of FY 1993.

- **FINDING C: Substitute Testing is Inadequate.** The GAO found that, rather than conduct follow-on operational testing, the Army is relying on technical tests to demonstrate system performance. The GAO concluded, however, that such tests are not a valid substitute for operational tests. The GAO explained that technical testing is essentially developmental testing and is not done in the realistic operational environment needed to evaluate system operational effectiveness and suitability. The GAO noted, for example, that tests to demonstrate the AVR-2 reliability were held in the contractor plant and were not done under the cognizance of the independent Army operational test organization. Moreover, the GAO concluded that DoD policy provides for demonstrating system operational effectiveness and suitability in operational tests--not technical tests.

The GAO reported that its other work has shown that, historically, failure to conduct operational testing to verify the adequacy of redesigned systems can result in adverse consequences. The GAO noted that, on a recent review of another Army electronic warfare system, it had found that design changes were made to correct a serious shortcoming discovered during operational testing. The GAO further noted, however, that no additional operational testing was done to verify the adequacy of the changes.

The GAO observed that, subsequently, during OPERATION DESERT STORM, the system proved so defective that Army pilots stopped using it.

In addition, the GAO observed that none of the substitute testing has been or will be done on the Army Apache helicopter, the main aircraft slated to use the AVR-2A. The GAO noted that, during a recent review of a Navy electronic warfare system, it found the system had successfully passed operational testing on a certain helicopter. According to the GAO, based on those tests, the Navy procured several hundred systems and then operationally tested the system on another helicopter scheduled to use the system. The GAO reported that the subsequent tests showed that the system degraded--rather than enhanced--the survivability of the other helicopter. Another limitation of the Army substitute testing noted by the GAO is illustrated by the AVR-2 electromagnetic compatibility tests. The GAO explained that the electromagnetic compatibility tests refer to the capability of systems to operate in their intended environment, without causing or suffering from interference with other systems. The GAO pointed out the AVR-2 electromagnetic compatibility tests were conducted on a Scout helicopter that had much of its electronic equipment either missing or inoperative. In addition, the GAO emphasized, the Scout does not have some equipment (such as the ALQ-136 radar jammer) that is used on the Apache and Cobra helicopters. The GAO concluded, therefore, that the Army has little assurance of the AVR-2 electromagnetic compatibility. (pp. 6-8/GAO Draft Report)

DOD RESPONSE: Partially concur. The AVR-2 was operationally tested by the Army in 1985 and in 1987 by the Navy. In reviewing the independent evaluation report of the operational test and assessing technical and first article test results, the Army Operational Test and Evaluation Command determined that system performance had been demonstrated and no critical operational issues remained that warranted follow-on operational testing. The Navy operational test determined the AVR-2 to be operationally suitable and effective. The Navy is currently conducting operational testing of the AVR-2 on a UH-1N helicopter. The Army plans to conduct a combined developmental test/operational test of the AVR-2A integrated on the AH-64 Apache later in FY 1993. Participants will include not only representatives from the Operational Test and Evaluation Command, but the Army user representative/combat developer from the Aviation Center at Fort Rucker. That testing will include bench, ground and flight testing and will verify system performance

Now on pp. 4-5.
See comment 3.

See comment 2.

See comment 8.

requirements, including electromagnetic interference/compatibility and weapon firings. Similar testing will be conducted on each Army aircraft designated to receive the AVR-2A.

* * * * *

RECOMMENDATION

- **RECOMMENDATION:** The GAO recommended that the Secretary of Defense require that production of the AVR-2 and AVR-2A be minimized until operational testing provides reasonable assurance that performance is satisfactory. (p. 8/GAO Draft Report)

DOD RESPONSE: Nonconcur. Adequate operational testing has been conducted or is planned reasonably to assure operationally suitable and effective performance of the AVR-2 and AVR-2A on Army and Navy aircraft. It continues to be the Department's position that production of the systems should proceed at the full-rate.

Now on p. 5.

See comment 7.

The following are GAO's comments on the Department of Defense's (DOD) letter dated December 16, 1992, and its accompanying enclosure.

GAO Comments

1. DOD's comment omits reference to the performance deficiencies detected in the 1985 tests, including the inability to detect multiple threats and operate properly with the helicopter's radar warning receiver and the tendency to provide false warnings. In addition, the AVR-2 failed to demonstrate that it met requirements for reliability, one of the prime factors in determining a system's operational suitability. Because system reliability requirements were not demonstrated, conclusions about the AVR-2's operational suitability were invalid.
2. The Navy tests found deficiencies similar to those revealed in the Army's 1985 tests. The Navy recommended that additional operational testing be conducted to verify that performance deficiencies had been corrected.
3. The Army's operational tester initially concluded that follow-on operational testing was needed to resolve performance deficiencies, but the Army canceled the tests because of Operation Desert Storm. Subsequently, based on the technical testing, the follow-on operational tests were deemed unnecessary. As discussed on page 5 of our report, these technical tests were not a valid substitute for operational tests.
4. As indicated on page 4 of our report, the cost of modifying the AVR-2 that was operationally tested in 1985 was about the same as its total original development cost. The modifications were made to correct deficiencies and improve system performance. In addition, the software for the AVR-2A has been partially rewritten and is not scheduled to be tested until February 1993. Thus, DOD cannot be certain about whether the modifications materially changed performance until the redesigned system is retested.
5. DOD policy clearly provides that a system's operational effectiveness and suitability shall be determined by operational testing. DOD policy does not provide for evaluating operational performance based on developmental testing, as was done on the redesigned AVR-2 and AVR-2A. As stated on page 3 of our report, developmental testing is done to determine whether a system is ready for operational testing.

6. At the time of our review, operational testing of the AVR-2 had revealed performance deficiencies, and no additional operational testing was planned to verify the adequacy of design changes. Subsequently, DOD agreed that operational testing on the Apache helicopter was needed. Despite DOD's disagreement with our recommendation, we consider DOD's action to be partially responsive to our recommendation, assuming that the additional tests are accomplished as planned. The additional tests should reduce acquisition risks, which could be further reduced by fully complying with our recommendation.

7. Whether the modifications improved system performance has not been demonstrated in operational testing.

8. These tests were planned in response to the draft of this report.